HOW TO GET THE BEST OUT OF YOUR JOB

Reprinted from the *Agricultural Journal* (Queensland) with the suggestion that it is good stuff for "Creed for 1928".

Respect it.
Take pleasure in it.
Don't feel above it.
Put your heart in it.
See the poetry in it.
Work with a purpose.
Do it with your might.
Go to the bottom of it.
Do one thing at a time.
Be larger than your task.
Prepare for it thoroughly.
Do it cheerfully, even if it is not congenial.
Do it in the spirit of an artist, not an artisan.
Make it a stepping stone to something higher.
Endeavour to do it better than it has ever been done before.
Do not try to do it with a part of yourself, the weaker part; be all there.
Keep yourself in condition to do it as well as it can be done.
Believe in its worth and dignity, no matter how humble it may be. Accept the disagreeable part of it as cheerfully as the agreeable.
Choose the vocation for which Nature has fitted you.
See how much you can put into it instead of how much you can take out of it.
Remember that it is only through your work that you can grow to your full height.
Train the eye, the ear, the hands, the mind—all the faculties—in the faithful doing of it.
Remember that work well done is the highest testimonial of character you can receive.
Use it as a tool to develop the strong points of your character and eliminate the weak ones.
Remember that every vocation has some advantages and disadvantages not found in any other.
Regard it as a sacred task given you to make you a better citizen, and to help the world along.

Remember that every neglected or poorly done piece of work stamps itself ineffaceably on your character.

Write it indelibly in your heart that it is better to be a successful cobbler than a botched physician or a briefless barrister.

Refuse to be discouraged if the standard you have reached does not satisfy you, that is a proof that you are an artist and not an artisan.

Educate yourself in other directions than the line of your work, so that you will be a broader, more liberal, more intelligent worker.

Regard it not merely as a means of making living, but first of all as a means of making a life—a larger, nobler specimen of manhood.

—O. S. M. in *The Dawn.*

"EVERY LITTLE BIT ADDED TO WHAT YOU'VE GOT MAKES A LITTLE BIT MORE"

Thrift in material matters means saving intelligently, spending prudently and investing wisely. We have learned many lessons well. We believe that education is a valuable investment. There are, however, lessons that we have not learned. We have not learned the habit of setting aside a definite sum each month for permanent investment. We need to learn this lesson.

The small amount of ten cents a day saved daily from the age of twenty-one to the age of sixty-four and invested permanently at the current rate of interest will amount to over four thousand dollars. Twenty cents a day for the same period at the current rate of interest will meet the demands of the statistician for the requirements of old age.

A banker recently said, "The power a man puts into saving measures to the power of the man in everything he undertakes.'

CHARLES FULLER BAKER.

Through wisdom is a house builded;
And by understanding it is established;
And by knowledge are the chambers filled
With all precious and pleasant riches.

—*Prov. 24:3, 4.*

CHEMICAL STUDIES ON COCONUT PRODUCTS: I. THE CRITICAL MOLDING-MOISTURE CONTENT OF COPRA, AND SOME METHODS OF PRESERVING IT.[1]

V. G. LAVA
Of the Department of Agricultural Chemistry

WITH ONE CHART

OBJECT OF THE PRESENT WORK AND REVIEW OF THE LITERATURE

The objects of these notes are to study the relation between the aqueous vapor tension of the atmosphere surrounding copra and its water absorption capacity and the effect of water upon the deterioration of copra by molds in presence of atmospheric oxygen, and to test some laboratory methods of copra preservation.

Among the important observations of different investigators, the following may be cited: Brill, Parker, and Yates (1927) found (1) That copra stored in open air will lose or gain water until this is in equilibrium with atmospheric moisture, the equilibrium point being reached when a moisture content of about 5 per cent is reached;

(2) That the water content of copra is not uniformly distributed, the layer adjacent to the water portion of the coconut containing more moisture than the layer near the shell;

(3) That when dried to a moisture content of 6 per cent, copra does not mold when stored where there is circulation of air, but that when kept in a saturated atmosphere, it will, after one or two weeks' exposure, absorb enough water to enable mold to grow;

(4) That while well-dried copra neither becomes hot nor evolves CO_2 when piled in storage, copra containing from 10 to 20 per cent moisture evolves CO_2 and increases the temperature of its surroundings; these two effects being parallel, and showing that the heat is produced by the deterioration of the copra;

(5) That copra (of moisture content 10-20 per cent) stored in a *bodega* loses very much weight through the action of molds, the green mold being the least harmful, and the brown mold destroying as much as 35 per cent of the oil in the copra within 30 days.

Walker (1906) and various other workers who have obtained somewhat similar results found

[1] Experiment Station contribution No. 479. Received for publication, August 12, 1927.

(6) That most of the free acid and the accompanying "rancidity" (*i.e.* the bad taste and odor) is produced in the copra itself before the oil has been expressed;

(7) That the destruction of fat with the consequent formation of a relatively large amount of acid in copra is caused by molds acting either alone or in conjunction with certain bacteria, a water content of 9-10 per cent (at a temperature around 35°C.) being the condition most favorable to the growth of these organisms; and

(8) That the destruction of the non-fatty portion of the copra is caused by several species of bacteria, this decomposition being accompanied by formation of only a very little acid, and occurring most favorably when the copra has a moisture content of 23-50 per cent.

Another point on the chemistry of rancidity which seems to have been agreed upon by investigators, such as Kerr (1921) and Emery and Henley (1922), and Powick (1923) is

(9) That rancidity results through the oxidation of fats by atmospheric oxygen in the presence of light or of certain metals as catalyst.

Regarding means of preserving copra, a few methods have been suggested. Thus in the *tapahan* system the creosote by-product of the destructive distillation of the shells and husks help in preserving the native copra, and it is because of the presence of this substance that copra with a moisture content of as high as 25-30 per cent may be allowed to stand for a few days without molding. In places where the desired product is white, artificial driers are used, and the copra is later subjected to SO_2 treatment. Observation in our laboratory and that of others shows that, as a preservative, SO_2 is very efficient. But the great drawback in the use of this substance is that where the oil is to be hydrogenated for edible purposes, the nickel catalyst is very easily poisoned by the presence of the sulfur compound.

Other chemicals have been suggested for copra preserving. Thus the use of boric acid was cited in the editorial in the *Agricultural Review* of September 18, 1909. Jarlien and Goonewardene (1926) proposed the use of alum, formaldehyde, potassium dichromate, chlorine, nitric acid, potassium permanganate and boric acid. The efficiency of these preservatives, however, has not been thoroughly tested.

Experimental methods and results

It is evident from conclusion (2) of Brill, Parker, and Yates that in order to determine the proper critical molding moisture content of copra, the size of each piece must be of such dimensions as to assure a nearly uniform passage of water from the edge to the center. To secure this uniformity, the samples of copra used in this investigation were passed through a grinder, the particles being approximately three millimeters in diameter.

Furthermore, in order to minimize the effect of the relative humidity, and thereby to regulate the amount of moisture in the surrounding atmosphere (and consequently, the amount of water absorbed in the copra), the samples should be surrounded by different aqueous solutions each of definite vapor tensions; for this purpose different concentrations of solutions of electrolytes, such as NaOH and NaCl were used.

As preliminary experiments to determine the course of the water absorption by copra, and its consequent molding, copra samples were ground and dried to zero per cent moisture, then placed over water in closed desiccators and the increase in weight determined every day, the desiccators being, of course, opened to the air after each weighing. Invariably, the greatest increase came during the first day, the increase in weight becoming less and less with longer exposure, until the weight became constant for a short time and then started to decrease. Molds appeared before the weight became constant. From the analysis of the samples after long exposure to the water vapor, it was evident that the loss of weight was due to the loss of oil, fiber, and possibly proteins and sugars. In the chart, *a* shows the relation between increase in weight of dried ground copra and time of exposure to saturated water vapor. In the same chart, *b* shows the relation between the increase in weight of dried ground copra and the time of exposure to an aqueous solution of SO_2.

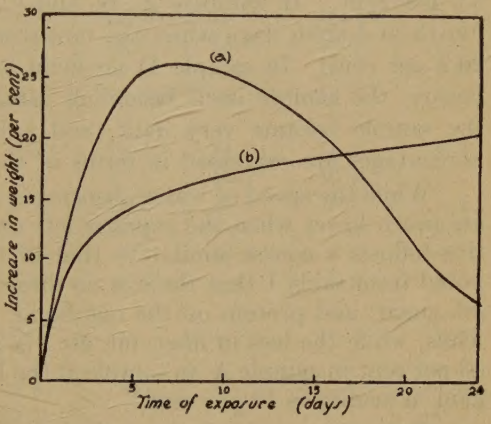

Chart 1.—Showing the change in weight of copra with exposure to saturated water vapor at room temperature.

TABLE 1

Comparison of the oil and acid contents of ground copra exposed to water vapor after different treatments

SAMPLE	LENGTH OF EXPOSURE TO WATER VAPOR	LOSS OF FIBER, OIL, ETC.	H_2O AND OTHER VOLATILE MATTER ABSORBED AT END OF EXPOSURE	OIL AND ACID IN DRIED MOLDED COPRA	ACID IN OIL (OLEIC ACID)
	days	*per cent*	*per cent*	*per cent*	*per cent*
A	34.6	33.2	46.0	30.5	43.0
B	31.6	35.0	36.4	25.7	19.2
C	16.0	15.2	40.2	28.9	19.4
D	165.0	1.4	120.0	55.5	1.1

Table 1 shows the results of analysis of dried ground copra exposed to water vapor in a desiccator. Sample A was taken from copra dried at 90°C. for 14.5 hours in a Freas electric oven, and was exposed to water vapor for 35 days. Sample B was taken from copra dried at 60°C. for 25 hours and exposed to water vapor for 32 days. Sample C was taken from copra dried at 60°C. for 39 hours and exposed to vapor for 16 days. Sample D was taken from copra dried at 60°C. for 24 hours and exposed to the vapor of an aqueous solution of SO_2 for 165 days. Before drying completely preparatory to exposure to saturated vapor[2], sample A had a moisture content of 7.3 per cent, sample B a moisture content of 7.4 per cent, sample C a moisture content of 4.8 per cent, and sample D a moisture content of 6.3 per cent. In samples A, B, and C, the molds appeared between the fourth and sixth days when the moisture content of the copra was around 20.2 per cent. In sample D no mold appeared throughout the entire exposure, the sample itself becoming rather bleached; on heating, however, the sample became very dark, and a loss in weight was observed. All percentages are expressed in terms of the dried copra.

While the speed of water absorption and the deterioration due to molds are much lower when the copra is left unground, it has been observed that this follows a course similar to that of the ground copra. It will also be noted from table 1 that there is no direct relation between the loss in fiber, oil, sugar, and protein on the one hand, and the acid formed on the other. Thus, while the loss in fiber, oil, etc., is 33 per cent, and the gain in acid is 43 per cent in sample A, in sample B the loss in weight is 35 per cent and the gain in acidity is 19 per cent.[3]

Since the vapor pressure of a pure solvent may be lowered by addition of any solute, advantage has been taken of this phenomenon to vary the vapor pressure of water surrounding different samples of copra. For this purpose the copra samples were placed over aqueous solutions of different concentrations of electrolytes, placed on metal gauze-covered dishes, the whole being covered by large funnels plugged with cotton wool on the stems; in this way, air can have access to the samples. In order to determine the equilibrium moisture content of the different samples exposed to these different vapor pressures, the ground copra was thoroughly mixed and two samples were placed inside each funnel. The samples were then weighed every day and the moisture content calculated on the dry basis. Any rancid odor or growth of mold was noted. At the end of a definite number of days, the samples were all dried at 100°C. to determine the loss in weight due to decomposition, and the oil and acid determined. Just before exposure, the moisture, oil, and acid contents of the whole sample were also determined.

[2] The temperature of the room varied from 24° to 29° C. throughout this part of the work.

[3] From our observations in conjunction with the Department of Plant Pathology of the optimum acidity condition for mold growth, we have found that the best growing condition for white, green, and brown molds is around pH 5.4 at room temperature.

TABLE 2

The course of water absorption of ground copra exposed to different aqueous tensions

TIME OF EXPOSURE	CHANGES IN WEIGHT OF COPRA BASED ON THE DRY WEIGHT, WHEN EXPOSED TO: [a]						
	Solid CaO	Saturated NaOH (20 N)	Saturated NaCl (5.5 N)	Normal NaCl	Normal H_2SO_4	H_2O	Atmosphere
days	*per cent*	*per cent*	*per cent*	*per cent*	*per cent*	*per cent*	*per cent*
0	8.7	8.3	12.7	13.0	8.4	12.5	12.5
1	4.7	3.4	9.2	12.3	10.8	13.0	9.9
2[b]	4.2	2.8	8.1	12.5	13.1	14.4	9.0
4	3.5	2.9	8.1	13.4	15.9	16.5	9.1
5	4.5	2.8	8.1	13.7	16.4	17.0	9.3
6	4.4	3.0	8.0	13.4[m]	16.1[m]	16.1[m]	9.0
7	5.5	2.8	7.8	12.7	15.8	15.2	9.1
8	6.5	2.8	7.8	12.6	15.5	15.1	9.3
9	7.8	2.7	7.2	11.3[hm]	15.7[hm]	12.8	7.4
10							
11	8.1	2.6	7.8	11.3	14.9	11.6	8.6
12	8.4	2.6	7.7	11.1	14.2	10.2	8.1
13	8.0	2.6	7.7	11.1	13.4	9.9	8.4
14	7.4	2.6	7.7	10.5	11.9	8.5	8.3
15	7.2	2.7	7.3[sr]	9.5	10.9	7.2	8.1[sr]
16	———	———	7.9	9.5	———	6.9	8.5
Average moisture content..	6.3	2.8	7.8	———	———	———	8.6
Max. variation from average...	−2.5, +2.4	−0.2, +0.2	−0.6, +0.3	———	———	———	−1.2, +0.7
Chemical analysis after exposure							
Loss of fiber, oil, etc., (per cent)	0.2	0.1	0.6	10.1	8.4	14.1	0.6
H_2O absorbed at end of exposure (per cent)	7.4	2.8	8.5	19.6	19.3	21.0	9.1
Oil and acid left (per cent).....	63.5	63.0	64.6	50.1	55.4	49.1	62.6
Acid produced (per cent).....	0.1	0.05	0.1	8.0	9.0	10.0	1.4

[a] Average relative humidity of room throughout experiment = 78.5 per cent.
[b] Equilibrium seemed to be attained at second day.
[m] Molding was first observed.
[hm] Heavy molding first observed.
[sr] Slight rancid odor first observed.
Room temperature ranged from 21° to 29°C.

Table 2 shows the course of the absorption (or dehydration) from the atmosphere of different water vapor pressures in presence of the air, and the results of analysis after 16 days exposure. To maintain the different

pressures, the samples were exposed to solid CaO, saturated NaOH solution, saturated NaCl solution, normal H_2SO_4 solution, normal NaCl solution, tap water and to the atmosphere alone. All percentage calculations are based on the dry weight of the copra. At the end of each exposure, the samples were dried at 100° in an electric oven. The difference between this dried weight and the weight of the dry copra if no molding took place, which was determined at the beginning of each experiment, gives the loss in fiber, oil, protein, etc. The residual percentage in weight after each day of exposure does not necessarily indicate the percentage of water left after the exposure. In some cases, as has been pointed out, when molding and consequent decomposition takes place, the residual percentage is the difference between the percentage water actually present and the percentage loss in fiber, oil, etc. Hence, the percentage water actually present may be calculated from the loss in fiber, oil, etc., and the residual percentage after each day of exposure. At the end of the final exposure, each sample was transferred to a Soxhlet extractor, and the oil and acid determined in the ordinary way.

Table 2 shows that the equilibrium moisture content may be lowered to around 3 per cent with the method of exposure described. Since it was observed that molding does not take place with this moisture content for at least many months, saturated NaOH solution was diluted to different degrees, with the object of increasing the vapor pressure of the water below the samples of copra to be used, and thereby producing copra of different amounts of absorbed water. In this way it was thought that an accurate determination of the critical molding moisture content may be made.

Table 3 shows the different equilibrum moisture contents, the loss of weight after a definite number of days in the funnels, the oil content, the acidity and the number of days before molds appeared. The maximum variations from the average equilibrium moisture contents are also given. Percentages are expressed on the dry basis.

The materials used to maintain the different vapor pressures in table 3 are saturated NaOH, 15N, 10N, 5N, 4N, 3N, 2N, N, NaOH, and saturated (5.5 N) NaCl solution. To insure molding under the given vapor pressure conditions of water, white, green, brown, and black copra molds obtained from the Department of Plant Pathology were injected after 11 days into the first seven samples, when the weights appeared to be constant.

With the use as dilute of a solution as (5N) NaOH, corresponding to a moisture content of 8.0 per cent, no mold was noticed; in the case of the (4N) NaOH solution, a thin whitish mold was observed at the end of the twentieth day, while molds appeared on the thirteenth day with the use of the (3N) NaOH and earlier in the case of the more dilute solutions.

It will also be noticed from table 3 that even if the same concentration of the NaOH is used, the equilibrium moisture content of copra is not the same. This is explained by the fact that the external relative humidity is

TABLE 3

The relation between equilibrium moisture content of ground copra and its deterioration

	AVERAGE EQUILIBRIUM H_2O [a]	MAXIMUM VARIATION FROM AVERAGE		TOTAL LOSS OF WEIGHT	OIL	ACIDITY IN OIL	NUMBER OF DAYS BEFORE MOLDS APPEARED	AVERAGE RELATIVE HUMIDITY [b]
		—	+	After 40 days				
	per cent	*per cent*	*per cent*	*per cent*	*per cent*	*per cent*		*per cent*
Sat. NaOH (20N)...	3.2	0.2	0.2	0.0	59.1	0.3	No molding	85
(15N) NaOH.....	4.4	0.4	0.3	0.1	57.9	0.5	"	85
(10N) NaOH.....	4.9	0.3	0.4	0.8	55.8	0.5	"	85
Sat. NaCl (5.5N)....	7.4	0.5	0.4	1.2	53.8	1.3	"	85
				After 25 days				
(5N) NaOH.....	8.0	0.6	0.5	3.0	51.6	1.3	No molding	81
(4N) NaOH.....	8.7	0.5	0.5	3.3	52.2	2.7	20	81
(3N) NaOH.....	9.5	0.9	0.8	5.9	44.3	10.7	13	81
(2N) NaOH.....				6.3	39.9	11.1	13	81
(N) NaOH.....				23.3	27.5	16.9	7	81
				After 25 days				
(7N) NaOH.....	7.1	0.2	0.3	0.0	61.7	1.1	No molds	87.5
(6N) NaOH.....	7.6	0.5	0.5	0.0	62.2	0.5	"	87.5
(5N) NaOH.....	9.1	0.5	0.9	0.2	61.6	2.7	21	87.5
				After 28 days				
(5N) NaOH.....	8.5	0.7	0.8	1.6	44.5	1.3	17	87
(4N) NaOH.....	9.4	0.4	0.3	3.7	41.9	9.0	13	87
(3N) NaOH.....	10.6	0.4	0.3	6.8	33.7	9.6	10	87
(2N) NaOH.....	11.7	0.7	0.8	8.0	30.6	12.2	10	87

[a] Room temperature ranged from 26°C. to 33°C.

[b] The relative humidity was determined by the Department of Plant Physiology.

exceedingly variable and changes the concentration of the solution very rapidly, frequent changes of the solution being required to maintain even an approximately constant aqueous tension.

It would appear, however, that under an external relative humidity of 81 per cent, copra may be kept at least a month with a water content of 8 per cent (dry basis) without molding or acquiring a rancid odor. It may be pointed out that copra exposed to air of low relative humidity will not mold, and that it is only when the relative humidity of the air is so high that water is absorbed by copra and thus exceeds the 8 per cent limit, that molding occurs. It is also to be noted that although neither mold nor rancid odor were noticeable during the heating for moisture determination, greater losses were incurred in the samples exposed to higher aqueous tension.

TABLE 4

Comparison of the effects of different preservatives on ground copra

PRESERVATIVE USED	H_2O AND OTHER VOLATILE MATTER AT THE END OF EXPOSURE	OIL	ACID IN OIL (OLEIC)	COLOR OF OIL
	per cent	*per cent*	*per cent*	
Formaline	11.7	59.6	0.5	Light yellow
Furfural	9.5	64.2	3.5	Yellowish white
Boric acid	18.0	63.0	2.5	Dark yellow
$Al_2(SO_4)_3$ solid	33.1	79.7?	7.3	Reddish yellow
$KMnO_4$ solution	37.4	42.2	2.4	Yellow
$K_2Cr_2O_7$ solution	35.9	38.2	2.7	Yellow
HNO_3 solution	32.7	43.8	4.7	Dark yellow
Over H_2O	42.0	47.1	2.3	Dark red
In air	6.4	52.9	0.5	Whitish

Table 4 gives the results of treating partially dried ground copra with different preservatives. Dilute solutions of $KMnO_4$, $K_2Cr_2O_7$, HNO_3 and H_3BO_3 were used. The formaline used was the 37 per cent solution. The Al_2 $(SO_4)_3$ used was in solid form. All the treated samples were placed over water and enclosed in funnels, to insure maximum conditions for molding. At the end of seven days copra exposed to water alone, and copra first treated with $Al_2(SO_4)_3$, $KMnO_4$ solution, $K_2Cr_2O_7$ solution, HNO_3 solution, and boric acid acquired mold growths, the rancid odor appearing along before the mold. In copra treated with boric acid, very few molds appeared, and with the use of formalin and furfural, after more than a month, no molds had appeared.

In table 4 the acidity and oil content cannot be taken as good indices of the extent of damage done to the copra since in some cases acids have been added to the samples, and in other cases the preservatives are soluble in ether; furthermore, different samples containing different oil contents were used. The better indices of the extent of damage are the observed quantity of molds together with the water absorbed at the end of the exposure and the color of the oil. Using these as the bases for determining the best laboratory preservatives, it would appear that formalin and furfural are the best among the chemicals so far studied.

SUMMARY

1. The effects of different molds and micro-organisms on the deterioration of copra containing varied moisture contents and in presence of oxygen are reviewed.

2. The critical molding moisture content of ground copra under an external relative humidity of 81 per cent and at room temperature is found to be 8 per cent. Although no molding and no rancid odor is observed in

the case of some samples exposed to higher aqueous tension, the losses in weight after heating at 100°C. is not negligible.

3. Regarding copra preservation, it would appear that formalin and furfural have possibilities. The results of studies on the use of these and other substances on a semi-industrial scale will follow.

4. In addition to the method of preservation given in (3) the use in bodegas of solid NaCl which can maintain a relative humidity of about 73 per cent, or of solid $NaNO_3$ which can maintain about the same relative humidity, at ordinary temperatures, is suggested. The use of the substances is economical, since after complete solution, they can be easily recovered by evaporation.

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AN EXPERIMENT IN THE USE OF A GRAIN DRILL IN REDUCING THE COST OF PLANTING RICE[1]

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WITH FOUR TEXT FIGURES

The rice imported in the Philippines in 1925, according to the Philippine Bureau of Commerce and Industry Statistical Bulletin for that year, amounted to 1,900,955 cavans (142,571,625 liters), valued at ₱12,826,439. The total production of rice in the Philippines for the same year was 22,231,041 cavans (1,667,328,075 liters) valued at ₱149,837,216.34, averaging ₱6.74 a

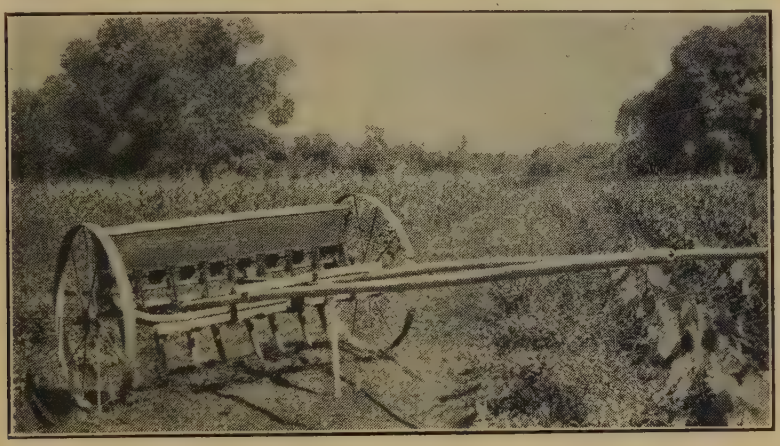

Fig. 1.—Climax Grain Drill as received by the College of Agriculture. The double tongue is the only change made.

cavan. Assuming ₱2.93 to be the cost of producing a cavan of palay, basing this assumption upon the records obtained from the farmers in the neighborhood of the College of Agriculture at Los Baños and from the cooperators in the same College, the total cost of producing the 1925 crop was ₱130,273,900.26. Any suggestion on culture methods that will tend to reduce the cost of production will help reduce the capital invested per cavan for this purpose. This saving will increase production by making it possible to grow more rice because of the capital thus made available.

[1] Experiment Station contribution No. 480. Read before the Los Baños Biological Club, September 1, 1927. Received for publication, September 26, 1927.

The main object of the investigation reported in this paper was to determine the possibility of lowering the cost of planting upland rice by ordinary methods with the native sowing implement and by using a modified standard imported grain drill.

MATERIALS AND METHODS

Climax grain drill

This drill is a standard grain drill imported from the United States; it bears the trade name "Climax". It has 8 spouts or rows, and the feed rollers are operated by 2 sprockets, one connected to the axle of the feed roller and the other one to the axle of the drive wheel. These two sprockets are connected by a sprocket chain. The amount of grain drilled per area of space is regulated by opening and closing the feeder slats. This drill

Fig. 2.—Climax Grain Drill after the improvements were made. Note the keel on the rim of the wheels which makes it run straight. The distance between the spikes are made wider also.

can be operated by one man and a bullock, by attaching to it a double tongue as shown in figure 1. The minimum amount of grain to the hectare that can be sown by this drill is about 35 gantas (105 liters), and the distance between the rows is about 17.78 centimeters.

The imported grain drill can not be used in the Philippines without making changes to adapt it to Philippine conditions, as for use here it has the following defects:

1. The least amount of seed it can plant per hectare without doing damage to the seed rice is about 32 gantas (96 liters), which is excessive.
2. The space between the rows is too narrow to accommodate the cultivator.
3. The drive-wheel has no guide or keel, thus it is impossible to make straight rows.

The first defect was remedied in the following way:

The operating part of the feeder of this drill, "Climax Grain Drill," consists of a driving sprocket gear having 6 teeth and a driven sprocket gear having 8 teeth. This driven sprocket gear is connected with the axle driving the grooved cylinder feeders. The only change that was made was to increase the number of the teeth of the driven sprocket gear from 10 to 16, thus reducing the revolution of the grooved cylinder feeder by about one-third. By this arrangement the amount of seed sown can be reduced to as low as 13 gantas (39 liters) to the hectare.

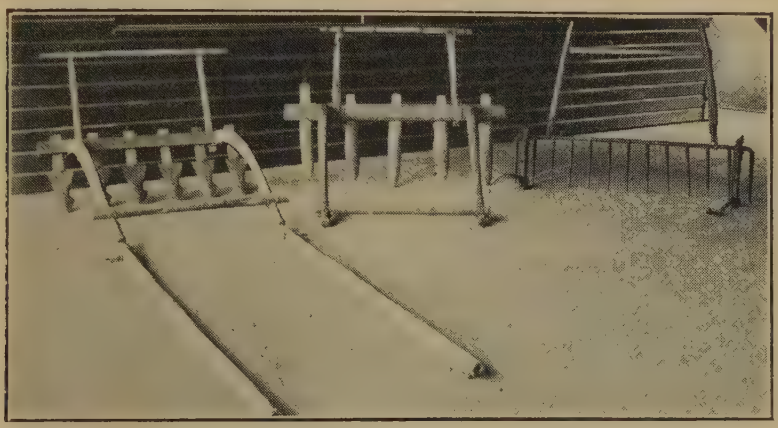

Fig. 3.—From left, first implements are lithaos. The first is an improvement on the second. Note the blade of the spikes made out of the blade of Acme weeding hoe, and the bamboo shafts instead of trace chains. These shafts steady the yoke which acts as a saw on the neck of the animal if trace chains are used. The third implement is an iron comb-tooth harrow.

In the neighborhood of the College of Agriculture, the standard distance between rows of upland rice which gives the best yield is 27 centimeters. As the standard grain drill has a distance of 17.78 centimeters, this distance was increased to 27 centimeters by changing the feed hopper and reducing the number of spouts from 8 to 6.

The drive wheels were improved by providing a keel or guide on each rim (see fig. 2).

To complete the outfit a double tongue made of bamboo was provided with a wooden yoke attached to one end.

Lithao

This is a native implement for marking the ground into furrows. It is shown in figure 3. In construction it is similar to the iron comb-tooth harrow as shown in same figure (3), only it is made of wood and the teeth are made from the trunk of Carryota palm. The lithao is about 1.12 meters

long and has five teeth. The teeth are about 30 centimeters long and are shaped like the blade of a spear. They are about 8 to 10 centimeters at the widest point.

EXPERIMENTS AND RESULTS

A portion of the Experiment Station ground, an area of approximately one and one-half hectares, was divided into three equal lots. Lot No. 1 was planted with the "Climax Grain Drill" on June 8, 1926, using 16 gantas (48 liters) of seed. The rows were about 27 centimeters apart. Lot No. 2 was marked with the lithao on June 7, 1926, and the seed sown the following day, using 37.3 gantas (111.9 liters) of seed, the seed being covered by running a harrow over the rows three times. Lot No. 3 was plowed ready for planting on June 7, 1926; 30 gantas (90 liters) of seed were broadcasted on the plowed ground the following day, and the ground was harrowed three times to cover the seed. In planting all three lots, the Inintiw variety of rice, giving 94.95 per cent germination by the rag-doll method, was used.

The first object of this experiment was to find, under field conditions, the difference in germination in the three treatments. The method used was to determine first how many seeds were sown per square meter; this was done by first counting the number of seeds in a ganta and dividing it by the number of square meters in each lot. The following results were obtained fifteen days after the time of seeding:

	Percentage of germination
Drilled	89.3
With lithao	66.1
Broadcasted	50.01

Each of these figures was the average of 20 different counts taken at random from each lot. These results show that 15 days after seeding the drill method gave 23.2 per cent better germination than the lithao and 39.29 per cent better than the broadcasted. Or, in terms of cavans, for every hundred cavans of seed used, the drill method used 23.2 cavans less than the lithao, and 39.29 cavans less than the broadcasted. In terms of pesos, at the rate of ₱4.00 a cavan, the drill compared with the lithao, saved ₱92.80, and compared with the broadcasted method, ₱157.16.

The second object of this experiment was to determine the amount of time required for one man and one animal with each of the implements used to plant a hectare. For the drill, with one man and one bullock it required 6 hours and 20 minutes. Basing calculations on the rate of 11.1 centavos an hour for both man and animal, the total cost was ₱1.405.

The lithao is an implement that cannot be handled by one man alone, hence to compute the cost, the different items in the procedure must be considered. These are:

For marking, two men and one bullock for 7 hours; for sowing seed, one man for 5 hours; for covering seed by harrowing twice, one man and one bullock for 12 hours and 30 minutes.

Using the same rate for one man and one bullock as with the drill method, that is, 11.1 centavos an hour, the total cost of operation was ₱5.66

With the broadcast method, the operations were itemized also: For plowing, one man and one bullock for 36 hours; for broadcasting, one man

Fig. 4.—Stand of rice planted with the improved grain drill. The stick is one meter long.

for 5 hours; for harrowing to cover the seeds, one man and one bullock for 16 hours.

The total cost of operation using the same rate as before, 11.1 centavos an hour, was ₱12.10.

Comparing the different costs of operation the data in table 1 were obtained:

TABLE 1

Giving the time, the number of men, the number of animals used and the total cost to plant a hectare, with each of the three methods

OPERATIONS	TIME TO PLANT A HECTARE	MEN REQUIRED	ANIMALS REQUIRED	TOTAL COST INVOLVED
	hours	*number*	*number*	*pesos*
Drill	6⅓	1	1	1.405
Lithao	51	2	1	5.660
Broadcasted	105	1	1	12.100

The drill requires one man and one bullock 6 1/3 hours, with the total cost of operation of ₱1.405 or ₱4.255 less than that required by the lithao, and ₱10.695 less than by the broadcast method.

Summarizing these three operations, it will be noted that in planting a hectare of ground the drill has the following advantages:

In economy of seed used, the drill required 42.6 gantas less than the lithao and 28 gantas less than the broadcast—using 32 gantas for the drill and 74.6 gantas for the lithao and 60 gantas for the broadcasted.

Time and labor were saved also because the drill with one man and one bullock planted a hectare in six hours and twenty minutes, whereas the lithao required two men and one bullock about two and a half days to plant the same area; and the broadcast method required five men and four bullocks one day.

In cost of operation the drill was ₱4.255 cheaper per hectare than the lithao and ₱10.695 cheaper than the broadcasted. Summing up all of these savings, the drill had to its credit the amount of ₱11.081 compared with the lithao and ₱15.175 compared with the broadcasted. Or by using the same capital, with the drill method one can plant about 9 hectares to one hectare with the lithao and about 11.8 hectares to one hectare with the broadcast method.

These statements are sufficient to show the importance of using the drill instead of the old methods in planting upland rice.

RECOMMENDATIONS

For satisfactory service the following is recommended in using a rice grain drill:

1. Have a good mellow deep soil.
2. Do not drill the seed when the ground is wet.
3. Do not allow any trash to accumulate at the point of the spout.
4. Use a disc furrow opener, if obtainable, but never use a shoe type furrow opener.

EFFECTS OF SUNLIGHT ON THE HATCHING QUALITY OF EGGS[1]

F. M. FRONDA AND JULIAN A. BELO
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WITH ONE TEXT FIGURE

The hatchers of duck eggs in the mammoth incubators in Pateros, Rizal Province, have for generations practiced the sunning of duck eggs prior to placing them in the large native incubators. (Raymundo, 1912; Burgos, 1924; Fronda, 1925–26.) Their object in doing this is to save the labor involved in the preliminary heating of the eggs. Although many new discoveries on the good effects of sunlight upon the growth and reproduction of animals have been reported, these hatchers are not aware of any such beneficial effects of direct exposure of eggs to sunlight upon their hatchability.

Following the suggestion that came to mind from this old practice of the hatchers of duck eggs in Pateros, a study was conducted by the senior author in 1925, using duck eggs hatched artificially. One-half of the number of eggs incubated were exposed to direct sunlight for fifteen to thirty minutes daily for the first fourteen days of incubation. The results obtained from this brief study were very significant. For this reason, more extensive trials were subsequently conducted.

REVIEW OF LITERATURE

There has been a considerable amount of literature published on the beneficial effects of sunlight on the cure and prevention of rickets, commonly called leg weakness among chickens, and on the growth and reproduction of organisms (Park, 1923). Only recent publications that have some direct bearing on this problem were consulted and are here reviewed.

Hughes, Payne, and Latshaw (1925) conducted experiments to determine the effects of ultra-violet light, either from the sun or from a mercury quartz lamp, on leg weakness of chicks, on the egg production of hens and hatchability of the eggs produced. From the results obtained they concluded, in part, that ultra-violet light will prevent leg weakness in growing chicks and that it has a marked beneficial effect on egg production and the hatchability of the eggs produced. These workers claimed that the variation in the hatchability of the eggs produced by hens receiving various

[1] Mr. Belo used the major part of the data herein reported in a thesis presented by him for graduation from the College of Agriculture, University of the Philippines, October, 1927. He was responsible for the incubation tests carried on from June, 1926, to April, 1927.

Thesis No. 259; Experiment Station contribution No. 481.

amounts of ultra-violet light was perhaps due to a variation in the antirachitic vitamin content of the eggs. Hughes, Payne, Titus, and Moore (1925) reported that the amount of ultra-violet irradiation which a hen receives is an important factor in determining the antirachitic vitamin content of the eggs which she produces, when her feed is low in the antirachitic vitamin. They also found that eggs which have a low antirachitic vitamin content do not have as high a hatchability as eggs having a high content of this vitamin, other factors influencing hatchability being constant. In a report of Hart, Steenbock, Lepkovsky, Kletzien, Halpin, and Johnson (1925), the statement is made that ultra-violet light greatly influenced the egg production of the hens exposed to it. The hatchability of the eggs produced was also greatly improved, while the fertility of the eggs was not consistently influenced by an abundance of the antirachitic factor. Direct exposure of the eggs to ultraviolet light, however, "had no influence whatever on the hatchability of the eggs, nor had it killed the living embryo".

In 1923, Herrick, Ackert, and Danheim stated that light, roomy, well-ventilated pens with clean straw litter are valuable assets in keeping chickens active and healthy. Kennard (1925) claimed that much of the benefit derived from having the birds out of doors is due to direct sunlight that they receive; these direct rays promote the health of the flock and also they appear to be essential for good hatchability of the hen's eggs. Hughes (1926) maintained that the lack of direct sunshine and not the lack of exercise on the soil is the cause of leg weakness when chicks are kept in the brooder house. He also claimed that the lack of direct sunshine is one of the causes of poor hatches in the early spring. These facts he explained by pointing out that vitamin D is developed in an animal when ultra-violet rays of the sun shine upon its skin.

Gowen, Murray, Gooch, and Ames (1926) reported that chickens that were fed milk from cows exposed daily from fifteen to thirty minutes to ultra-violet light remained in good condition. They also found that more of the substance necessary to cure rickets is absorbed by the cow exposed to ultra-violet light and secreted by her in her milk. Steenbock, Hart, Hoppert, and Black (1925) reported that by exposure to the radiations of a quartz mercury vapor lamp, the antirachitic properties of cow's milk were increased eight or more times, and under the same conditions, a sample of goat's milk increased in activity about twenty-four times. They also found that this increase in activity could be induced rather promptly, though to a lesser degree, by direct irradiation of the animal.

To determine the factor responsible for the prevention and cure of leg weakness in chicks, Bethke, Kennard, and Kik (1925) of the Ohio Agricultural Experiment Station, in an experiment with White Leghorn chicks, found that direct sunlight proved effective as an antirachitic agent. Their results show that one-half hour of direct sunlight is more effective than

green clover in preventing leg weakness in chicks. The authors concluded that the benefit in turning chicks out of doors to prevent or cure leg weakness is mainly due to the effect of radiant energy supplied by direct sunlight. Again, Ackerson, Blish, and Mussehl (1925), in studies also with White Leghorn chicks, at the Nebraska Experiment Station, found that a supplement of direct sunlight prevented the occurrence of rickets in chicks which were normal as far as growth was concerned.

Hughes (1924) reported that young chicks receiving a standard scratch feed and mash supplemented with sprouted oats and fresh butter-milk developed rickets if they were kept in a room where the light is filtered through glass, while those receiving the same treatment but exposed to direct sunlight a few hours each day developed normally. Working on experimental rickets, Hess, Unger, and Pappenheimer (1922) found that the effect of fifteen minutes daily exposure to sunlight was about equivalent to doubling the protective dose of phosphorus in rats. Hart, Steenbock, Lepkovsky, and Halpin (1923) reported that light acts as a supplement or the equivalent to the antirachitic factor of food stuffs in raising baby chicks. They also reported that an abundance of sunlight or irradiation by ultra-violet light electrically produced will prevent leg weakness.

It has been reported also that sunlight has a curative effect on rickets among infants (Hess and Unger, 1921). Later, Hess and Gutman (1921), also working on the cure of infantile rickets, found that sunlight not only brings about a cure of rachitic lesions, but also occasions chemical changes in the blood similar to those noted when the cure is effected by cod-liver oil. Again, Chick, Dalyell, Hume, Mackay, and Smith (1922), all of the Vienna University Kinderklinik, working on the etiology of rickets in infants, found that the cure was most marked in cases receiving cod-liver oil and exposure to sunlight simultaneously. In cases where no cod-liver oil was used the rate of bone healing was proportional to the amount of exposure.

That the egg yolk has marked antirachitic properties for both animals and infants has been repeatedly shown (Hess, 1923; Casparis, Shipley, and Kramer, 1923; Hughes, Payne, Titus, and Moore, 1925; Hart, Steenbock, Lepkovsky, Kletzien, Halpin, and Johnson, 1925; and Heuser and Norris, 1926). But Heuser and Norris (1926) expressed the opinion that it is probable that the antirachitic potency of eggs is influenced by seasonal variations in the amount of sunshine and conditions of confinement, for the same reason that the vitality of chicks varies widely with the season of the year in which the eggs are laid. In this connection it has been reported by Hart and his associates (1925) that the antirachitic potency of yolks of eggs produced by hens that have been irradiated is increased to about ten times that of egg yolks from non-irradiated hens. Similarly the studies of Steenbock, Hart, Elvehjem, and Kletzien (1925) have conclusively proved that the antirachitic properties of hays are related to their exposure to sunlight.

It has been reported that even foods containing lipoidal properties can be endowed with specific antirachitic potency by ultra-violet irradiation. Steenbock and Nelson (1924-25) reported that a ration which induced rickets in the rat has been made antirachitic by the simple exposure of it to ultra-violet light. Hess and Weinstock (1924–25) and Hess (1925) reported that cottonseed oil, linseed oil, and even green tissues had been made antirachitic by irradiation. These materials before treatment do not have any antirachitic values. Again, Steenbock and Daniels (1925) reported success in thus activating such foodstuffs as lard, butterfat, olive oil, coconut oil, cottonseed oil, and corn oil. Hess and Weinstock (1925) stated that wheat which has been irradiated by ultra-violet light retains its antirachitic potency for weeks. In a later report, Hess, Weinstock, and Helman (1925) added phytosterol prepared from cottonseed oil, cholesterol, a crystalline preparation extracted from brain tissue, and lanolin as substances that have been made antirachitic by irradiation with the quartz mercury vapor lamp. However, Mussehl, Hill, and Rosenbaum (1926) reported that irradiation of fresh corn oil for thirty to sixty minutes only slightly enhanced its antirachitic property. They further stated that irradiation of yellow corn and white corn for thirty minutes before grinding did not enhance to any appreciable degree their antirachitic values. The trials of these authors were made on chicks given a ration complete except for the antirachitic factor.

All of these observations point out that vitamin D (antirachitic vitamin) is developed in an organism when ultra-violet rays of the sun shine on its skin. Also, this vitamin is developed inside products containing lipoidal substances when these are exposed to ultra-violet rays. Different investigators on the mineral metabolism of an animal have shown also that exposure either to sunlight or to quartz mercury vapor lamp improves the calcium assimilation, and thus a positive calcium balance is produced in an animal. Hart and his associates (1924) showed that lactating goats in a negative calcium balance on a ration deficient in antirachitic factor, when irradiated ten to twenty minutes daily by quartz mercury vapor lamp would be put in a positive calcium balance. In a later report Hart and his co-workers (1926) gave findings that showed that direct exposure of cows to sunlight improved the utilization of calcium, and this treatment was instrumental in bringing about equilibrium in cows producing twenty-five to thirty pounds of milk. Maynard, Goldberg, and Miller (1925) concluded in their study on the influence of sunlight on bone development in swine that sunlight has a marked influence on the mineral metabolism of growing pigs that are fed a ration low in calcium and presumably low also in the factor aiding calcium assimilation. They observed also that sunlight increased the ash content of the bones, and, in general, the pigs exposed to sunlight had bones more normal than had those raised indoors. Similarly Bohstedt, Bethke, Edgington, and Robison (1927) reported that pigs on a ration deficient in calcium salts and in vitamins A and D made

better gains and grew denser and stronger bones when exposed to direct sunlight than pigs on the same rations but kept indoors. Steenbock, Hart, and Jones (1924) also reported that direct sunlight improved the mineral metabolism and stimulated the growth of pigs.

The most direct report found along this line with eggs is that of Hart and his associates (1925) in which they observed that the amount of lime in the shell is increased markedly by irradiation of hens. They also reported that the calcium content of the developing embryo at twenty-one days is nearly twice as much as the embryo from non-irradiated hen's eggs. Again, Ackerson, Blish, and Mussehl (1925) found that chicks receiving cod-liver oil additions or direct sunshine have sera that have slightly higher contents of calcium and inorganic phosphorus than with chicks where the antirachitic factor was withheld. In connection with this, it may be well to call attention to the claim of Riddle (1924) that in pigeons one of the functions of the thymus is to govern the disposition of the shell and the albumen of the egg. For this hypothetical hormone, he proposed the name *thymovidin*. Collip (1925), however, has obtained a powerful extract of the parathyroid by which it is possible to increase the calcium content of the blood to any desired degree. These two later reports are of value in correcting the impression that vitamin D and light are the all-important factors in calcium metabolism.

On the other hand, the works of Hart and co-workers (1921; 1922; 1923; 1924) point out that a vitamin or the vitamins that are present in green plants and in properly cured hays assist in the assimilation of calcium and phosphorus. They showed that cattle can utilize calcium and phosphorus more efficiently when the ration contains fresh green plant tissues, and for this reason, they believe that this effect of green plant tissues is due to the presence of antirachitic vitamin which is less active in dry hays. Thus, in the opinion of these investigators, a good assimilation of calcium results in the presence of the antirachitic vitamin, which can be developed in the food on exposure to sunlight, or when irradiated by quartz mercury vapor lamp. However, Hunt, Winter, and Miller (1923) also have shown that "possibly the difference between green and dry hay in causing a difference in the assimilation of calcium is partly due to the difference in the physical properties (fineness of division) of the cell content of the two hays, and therefore a difference in the digestibility."

OBJECT OF THE PRESENT WORK

While these numerous reports show that direct sunlight has marked beneficial effects, the effects on hatching eggs when exposed directly to sunlight have not been determined. The object of this work was to determine the effects on the hatchability of exposure of hatching eggs to direct sunshine. Also an endeavor was made to find out just how much exposure

to sunlight will produce the best effects on the hatching quality of the eggs, and thus determine whether or not sunning of the hatching eggs during the incubation processes would be profitable if put into actual practice.

The work was conducted in the Department of Animal Husbandry, College of Agriculture, University of the Philippines, at Los Baños, Laguna. It was begun in August, 1925, and closed April, 1927.

MATERIALS AND METHODS

Materials

The materials used in this work were 114 duck eggs, and 1267 chicken eggs, a 250-hot water Queen incubator, and pedigree bags.

Methods

Artificial incubation was employed throughout. Six settings in all were made. One hundred and fourteen duck eggs were used in the first setting, which was a trial setting, and made in August 1, 1925. The eggs were divided into two lots, lots 1, and 2. In lot 1, the check lot, there were 57 eggs; in lot 2, the experimental lot, there were also 57 eggs; this lot received sunlight treatment fifteen to thirty minutes daily during the first fourteen days of incubation.

TABLE 1

Showing hatching results with duck eggs
(First setting)

	LOT 1 (UNSUNNED)	LOT 2 (SUNNED)
Number of eggs set	57	57
Number of infertile eggs	1	2
Percentage D_1[a]	1.79[b]	7.27[b]
Percentage D_2[a]	5.36	0.00
Percentage D_3[a]	51.78	41.81
Percentage pipped	1.79	0.00
Percentage hatched	39.28	50.91

[a]Eggs, germs of which died during the first and second testings, and those that did not hatch at the end of the incubation period.

[b]All percentages are based on fertile eggs.

The second setting was made June 20, 1926. Two hundred and sixty-seven chicken eggs were used in this setting. The eggs were divided into lots 1, 2, 3, 4, and 5. In ot 1, the check or the unsunned ot, there were 57 eggs; there were 57 in lot 2; 57 in lot 3; 51 in lot 4; and 51 in lot 5. Lots

2, 3, 4, and 5 were the experimental lots and received sunlight treatment as follows:

Lot 2 was sunned thirty minutes just before placing the eggs in the incubator,

Lot 3 was sunned thirty minutes immediately before placing the eggs in the incubator and thirty minutes every six days thereafter until the eighteenth day of incubation.

Lot 4 was sunned thirty minutes just prior to placing the eggs in the incubator and thirty minutes every three days thereafter until the eighteenth day of incubation.

Lot 5 was sunned thirty minutes immediately before placing the eggs in the incubator and thirty minutes every day thereafter until the eighteenth day of incubation.

TABLE 2

Showing results of the second setting

LOT NO.	NUMBER EGGS SET	NUMBER FERTILES	D1[b]		D2[b]		D3[b]		PIPPED		HATCHED	
			Number	Percentage[c]	Number	Percentage	Number	Percentage	Number	Percentage	Number	Percentage
1	57	55	11	20.00	10	18.18	9	16.36	2	3.64	23	41.82
2	56[a]	49	8	16.33	6	12.24	11	22.45	2	4.08	22	44.90
3	51	43	8	18.60	3	6.98	5	11.53	1	2.33	26	60.47
4	51	47	5	10.64	5	10.64	4	8.51	1	2.13	32	68.09
5	50[a]	47	9	19.15	2	4.25	6	12.77	0	0	30	63.83

[a] One egg from each of these lots was accidentally broken. Such eggs were deducted from the total number in the lot and considered as if not set at all. They were broken during the process of candling.

[b] Eggs, germs of which died during the first, second, and third weeks of the incubation period.

[c] All percentages are based on fertile eggs.

All the eggs in the lots were set in the same incubator. The incubator had two egg trays, and in the first setting, one lot was placed in one tray and the other lot in another tray. In the subsequent settings, lot 1, the check lot, was divided into two sub-lots and one sub-lot was placed in each egg tray. The eggs were turned twice a day and the places of the egg trays were interchanged, the idea being to subject, so far as possible, all the lots to the same conditions in the incubator. Figure 1 shows the two egg trays and the way they were partitioned. The broken lines represent the bamboo

partitions, separating the lots from each other. Sub-lots 1-a and 1-b constitute the check lot while lots 2, 3, 4, and 5 represent the experimental lots.

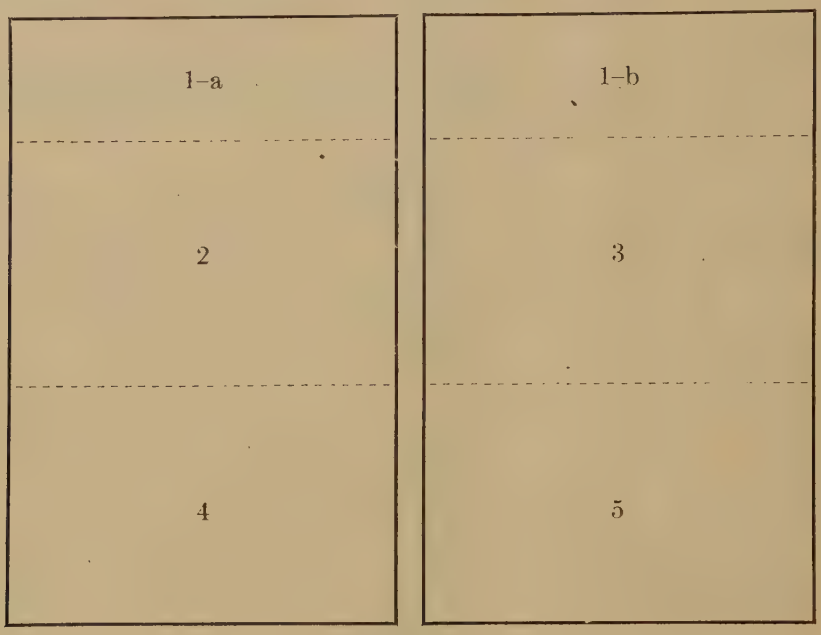

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Fig. 1.—The two egg trays; showing how they were partitioned.

Sunning. When the eggs in the experimental lots were to be exposed to direct sunlight, the two egg trays were removed from the incubator and placed on a table in the incubator cellar. The eggs to be sunned were transferred to a third tray and at once exposed to direct sunlight, while those not to be sunned were returned to the incubator. After the process

TABLE 3

Showing results of the third setting

LOT NO.	NUMBER EGGS SET	NUMBER FERTILES	D_1		D_2		D_3		PIPPED		HATCHED	
			Number	Percentage	Number	Percentage	Number	Percentage	Number	Percentage	Number	Percentage
1	49[a]	41	17	41.46	1	2.44	4	9.76	2	4.88	17	41.46
2	50	43	11	25.58	2	4.65	2	4.65	1	2.33	27	62.79
3	50	45	12	26.67	3	6.67	10	22.22	1	2.22	19	42.22
4	49[a]	45	10	22.22	1	2.22	4	8.89	0	0	30	66.67
5	50	46	9	19.56	2	4.35	5	10.87	0	0	30	65.22

[a] One egg from each of these lots was accidentally broken during incubation. Such eggs were deducted from the total number in the lot and considered as if not set at all. They were broken during the process of candling.

TABLE 4

Showing results of the fourth setting

LOT NO.	NUMBER EGGS SET	NUMBER FERTILES	D_1		D_2		D_3		PIPPED		HATCHED	
			Number	Percentage	Number	Percentage	Number	Percentage	Number	Percentage	Number	Percentage
1	50	47	6	12.77	2	4.26	3	6.38	3	6.38	33	70.21
2	50	44	4	9.09	2	4.55	4	9.09	2	4.55	32	72.73
3	50	46	4	8.69	2	4.35	10	21.74	0	0	30	65.22
4	50	46	5	10.87	2	4.35	4	8.70	1	2.17	34	73.91
5	50	42	3	7.14	2	4.76	3	7.14	0	0	34	80.95

of sunning, the two egg trays were again removed from the incubator and the treated eggs transferred at once to them and returned to the incubator. It may be mentioned here that with great care in the process of sunning no egg need be broken. In this experiment not a single egg thus handled was broken; the few broken eggs reported were damaged in the process of candling.

The third setting was made on December 1, 1926, the fourth on January 7, 1927, the fifth on February 1, 1927, and the sixth on April 5, 1927. In each of these settings 250 Cantonese eggs were used. The eggs in each of the last five settings were divided into five lots, taking all possible care that the eggs were divided equally as to age.

Testing. On the seventh day of each setting, the eggs were candled and the infertiles and those having dead germs were removed. All the infertile and doubtful eggs were broken into a saucer to determine accurately whether they were really infertile or had germs that died very early. Thus real infertility and not "apparent infertility" was determined. On the fourteenth day of incubation, the eggs remaining in the incubator were again candled. In all cases, the eggs were numbered before setting. On the twenty-seventh day of incubation in the case of the duck eggs, and on the eighteenth day in the case of all chicken eggs, these were put in pedigree bags so as to be sure that the chicks did not get mixed when the hatch was completed.

RESULTS

Careful records were made of all eggs set: in duck eggs of infertile eggs, embryonic mortality in the first, second, third, and fourth weeks, and the ducklings that hatched; and in chicken eggs of infertile eggs, embryonic mortality in the first, second, and third weeks, pipped eggs, and the chicks

that hatched. The results of the six settings are shown in tables 1, 2, 3, 4, 5, and 6. Table 7 shows the average percentage of embryonic mortality

TABLE 5

Showing results of the fifth setting

LOT NO.	NUMBER EGGS SET	NUMBER FERTILES	D1		D2		D3		PIPPED		HATCHED	
			Number	Percentage	Number	Percentage	Number	Percentage	Number	Percentage	Number	Percentage
1	50	46	6	13.04	4	8.70	7	15.22	1	2.17	28	60.87
2	50	47	5	10.64	1	2.13	11	23.40	0	0	30	63.83
3	50	43	6	13.95	1	2.33	6	13.95	0	0	30	67.77
4	50	44	2	4.55	1	2.27	8	18.18	1	2.27	32	72.73
5	50	41	3	7.32	1	2.44	8	19.51	0	0	29	70.73

TABLE 6

Showing results of the sixth setting

LOT NO.	NUMBER EGGS SET	NUMBER FERTILES	D1		D2		D3		PIPPED		HATCHED	
			Number	Percentage	Number	Percentage	Number	Percentage	Number	Percentage	Number	Percentage
1	50	46	4	8.70	3	6.52	7	15.22	0	0	32	69.56
2	50	45	2	4.44	1	2.22	6	13.33	1	2.22	35	77.78
3	50	47	2	4.26	2	4.26	7	14.89	0	0	36	76.60
4	50	46	3	6.52	0	0	2	4.35	0	0	41	89.13
5	50	46	2	4.35	2	4.35	3	6.52	0	0	39	84.78

during the first, second, and third weeks including the pipped eggs in each lot in the trials in which only chicken eggs were used. Table 8 shows the average percentage of hatch of these same lots together with the corresponding probable errors. The formula used in computing the probable errors was Bessel's[2] (Mendiola, 1925).

DISCUSSION OF RESULTS

Hatchability

In the first trial, a significantly higher percentage of hatch was obtained from the sunned lot than from the unsunned. In the second, third, fifth, and sixth settings, the highest percentage of hatch was obtained in lot 4, the lot which was sunned thirty minutes prior to being put in the incubator and thirty minutes every three days thereafter until the eighteenth day. In the fourth setting, however, the best hatch was obtained in lot 5, the lot

[2]This formula is as follows:

P. E. (Probable error of mean of several items) $= \pm 0.6745\sqrt{\frac{\Sigma d^2}{n\,(n-1)}}$ in which d refers to the deviation of the different items from their mean; n the number of items and Σ shows that the values d^2 are to be added. In determining the probable error of the difference the formula used was $\pm\sqrt{A^2+B^2}$, in which A represents the probable error of one mean and B that of the other.

which was sunned thirty minutes prior to setting in the incubator and thirty minutes every day thereafter until the eighteenth day. In the second, third, fifth, and sixth settings, lot 1, the check lot, gave the lowest percentage of hatch. In the fourth setting, however, the lowest percentage of hatch was in lot 3, the lot which was sunned for thirty minutes before setting and thirty minutes every six days, thereafter. Perhaps the reason for this result was the rather poor sunning this lot received; as the days were cloudy, all four sunnings, except the first, were poor. Lots 4 and 5 were exposed to sunlight at the same time that lot 3 was exposed, but they received good sunning at other times when lot 3 was not exposed.

Table 7 gives the summary of the last five hatchings in terms of average percentages. As shown in this table, lot 2 and lot 3 gave better hatchability than lot 1, the check. The probable errors of the differences were

TABLE 7

Showing the distribution of embryonic mortality in the last five settings only

LOT NO.	TOTAL NUMBER OF EGGS SET	TOTAL NUMBER OF FERTILE EGGS	PERCENTAGE EMBRYONIC MORTALITY				TOTAL
			D_1	D_2	D_3	Pipped	
1	256	235	19.19	8.02	12.59	3.41	43.21
2	256	228	13.22	5.16	14.58	2.64	35.60
3	251	224	14.43	4.92	16.89	0.91	37.15
4	250	228	10.96	3.90	9.73	1.31	25.89
5	250	222	11.50	4.03	11.36	0	26.89

computed and it was found that in each of these cases the difference was not large enough to be significant. From lots 4 and 5 the best results were obtained, the difference between their hatchability and that of the check lot are significant, being 17.33 ± 5.09 per cent for lot 4 and 16.32 ± 5.16 per cent for lot 5, and for lot 4, 3.4 times its probable error, for lot 5, 3.2 times. Lot 4 had a higher percentage of hatchability than lot 5. Sunning eggs for thirty minutes every three days until the eighteenth day of incubation might be considered better than sunning eggs every day for the same period, as less labor is required and there is a slight difference in percentage of hatchability in favor of the sunning every three days.

From the results obtained it appears that sunning eggs thirty minutes prior to setting in the incubator and every three days thereafter, as well as every day until the eighteenth day of incubation, has pronounced favorable effects in increasing their hatchability. As has been stated elsewhere, vitamin D may have developed when ultra-violet light shone upon the eggs exposed. Also, as claimed by other investigators, it is evident that some active principle, which was presumably vitamin D, may have been developed in the eggs during the process of sunning, and this active principle favored the growth and development of the embryo chicks inside, hence better hatchability resulted. As has been observed by Hart and his associates

(1925), by Ackerson, Blish, and Mussehl (1925), and by Bohstedt and co-workers (1927), this direct exposure of the eggs to sunlight may have aided in the assimilation of calcium from the egg shells. As claimed in the investigations of Hart and his associates, the presence of the antirachitic vitamin, vitamin D, may have materially influenced this increased calcium assimilation from the egg shells of the sunned eggs. Whether or not this is the case, it is very evident that the more direct sunning the eggs received, the better was the hatchability of these eggs. These results differ from those obtained by Hart and his associates (1925) who observed that direct exposure to ultra-violet light had no influence whatever on the hatchability of the eggs. Hess (1925) also stated that even the tenuous skin that surrounds the hen's egg seems to intercept the progress of the ultra-violet rays to a greater or less degree.

Embryonic mortality

In the first setting, the percentage of embryonic mortality was higher in lot 1, the unsunned lot, than in lot 2, the sunned lot. In the second setting, it was highest also in the unsunned lot and lowest in lot 4, the lot which was sunned for thirty minutes just prior to setting and every three days thereafter until the eighteenth day of incubation. The results of the third setting show that the percentage of embryonic mortality was again highest in lot 1, the unsunned lot, and lowest in lot 4. In the fourth and sixth

TABLE 8

Showing average percentage of hatchability of the last five settings

LOT NO.	PERCENTAGE HATCHED	DIFFERENCE BETWEEN EXPERIMENTAL AND CHECK LOTS	PROBABLE ERROR OF DIFFERENCE	CHANCES
1	56.78±4.32	———	———	———
2	64.41±3.79	+ 7.63	±5.66	Insignificant
3	62.86±3.91	+ 6.08	±5.83	Insignificant
4	74.11±2.69	+17.33	±5.09	Significant
5	73.10±2.83	+16.32	±5.16	Significant

settings, embryonic mortality during the first two weeks of the incubation period was again highest in the unsunned lot. In the fourth setting, however, embryonic mortality during the first week was highest in the lot which was sunned every six days and next highest in the unsunned lot.

During the third week of the incubation period, embryonic mortality in the second setting was highest in lot 2, the lot which was sunned just before setting, and lowest in lot 4. In the third setting it was highest in lot 3, the lot which was sunned every six days, and lowest in lot 2. In the fourth setting it was highest in lot 3 and lowest in lot 5, the lot which was sunned daily until the eighteenth day of incubation. In the fifth setting the embryonic mortality was highest in lot 2 and lowest in the unsunned lot, but in the sixth setting it was highest in lot 1 and lowest in lot 4.

It is interesting to note that in all of the last five settings there was no pipped egg in lot 5, the lot which was sunned daily until the eighteenth day of the incubation period. On the other hand, the average percentage of pipped eggs in lot 1 was 3.41 per cent; in lot 2, 2.64; in lot 3, 0.91; and in lot 4, 1.31 per cent.

Table 7 shows the distribution of embryonic mortality in the last five settings. As may be seen in this table, the average percentage of embryonic mortality during the first two weeks of the incubation period was highest in the unsunned lots and lowest in the lots that were sunned either every three days or daily. During the third week of the incubation period, however, the average percentage of mortality was found to be highest in the lot which was sunned every six days and lowest in the lot which was sunned every three days. The average percentage of embryonic mortality during the third week was found to be higher in lots 2 and 3 than in lot 1, the unsunned lot. The average embryonic mortality during the first two weeks of incubation was high in the unsunned lot and in the lots which were sunned not more than once every six days. The beneficial effects derived from sunning eggs in the process of incubation seem to be especially marked during the first two weeks of embryonic development. The influence of sunning on the third week of incubation is not very marked, but its effect on the percentage of pipped is rather significant. As has already been stated elsewhere, some active principle, presumably vitamin D, may have been developed among the sunned eggs and was responsible for their better hatchability. As has also been mentioned, the presence of this active principle may have materially increased the vitality of developing embryo chicks, and consequently lowered the percentage of embryonic mortality. Also, the presence of this principle may have brought about a better assimilation of the calcium in the egg shells, thus promoting the better development of the bony tissues and making the chicks stronger to break through their egg shells at hatching time. The absence of pipped eggs in the lot that received the most exposure to sunlight, and the almost insignificant number in the other lots that received slightly less sunshine may have been due to this. However, only actual analysis of the chicks at the time of hatching could show this, and on this phase of the work, we are not ready to report.

The slight difference in temperature to which the eggs were subjected when being exposed to sunlight and when not exposed at all may have had some effect on these differences in hatchability and embryonic mortality. Hess (1922) in his paper on the influence of light in prevention and cure of rickets stated that the protective action of light waves in the prevention of rickets cannot be attributed to temperature; however, his statement was perhaps not justified in the experiment. Hess, Unger, and Pappenheimer (1922) in their study on the cure of rickets found that "fully as great protection was afforded at 18°C. as at 29°C., almost no rickets developing in groups of rats exposed at either temperature." Powers, Park, and Sim-

monds (1923) state in this connection that it is possible that temperature has little influence on the process by which calcium salts are deposited in the bone. Their studies on the effect of radiant energy on xerophthalmia brought out the remarkable fact "that sunlight and out-of-door air with such factors as may be associated with them have wonderful health and life-giving powers which enable the animal to adapt itself with a considerable degree of success to adverse environmental conditions." In their opinion sunlight and out-of-door air supply something which raises the level of cellular function. It is very possible that this something that these investigators claim is supplied by sunlight and out-of-door air is the antirachitic vitamin, as claimed by the various investigators previously cited. Hughes, Nitcher, and Titus (1925), in comparing the values of ultraviolet light and irradiated air in preventing rickets, arrived at the conclusion that "the beneficial action of ultra-violet light in preventing rickets in chickens is due to its direct action on the chickens and not to changes which it produces in the air the chickens breathe." The observations of Nelson and Steenbock (1925) also confirmed this view; they concluded that no valid evidence was obtained to show that irradiation with ultra-violet light will confer growth-promoting or antirachitic properties on air.

SUMMARY OF CONCLUSIONS

1. The unsunned lots gave the lowest percentage of hatch.

2. Sunning eggs just before placing them in the incubator without subsequently repeating the operation, as well as sunning them just before placing in the incubator and every six days thereafter until the eighteenth day of incubation, produced no significant increase in the percentage of hatch over eggs that were not sunned.

3. Sunning eggs prior to placing them in the incubator and either every day or every three days thereafter until the eighteenth day of incubation, resulted in a significant increase in percentage of hatchability.

4. The average embryonic mortality during the first two weeks of incubation was high in the unsunned lot and in the lots that were sunned not more than once every six days during the incubation period.

5. Sunning the eggs either every three days or daily resulted in a significantly lower percentage of embryonic mortality during the first two weeks of incubation, than with unsunned eggs.

6. The beneficial effects derived from sunning eggs in the process of incubation seem to be especially marked during the first two weeks of embryonic development.

7. The total embryonic mortality was lowest in the lots that were sunned every three days or daily.

8. Sunning eggs every three days may be considered better than sunning eggs every day, as much labor is thereby saved.

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ABSTRACT

A study of the cost of production and distribution of income of tobacco in Ilagan, Isabela. ULPIANO V. MADAMBA. (*Thesis presented for graduation, 1924, from the College of Agriculture No. 260; Experiment Station contribution No. 482*).—The survey was made during the early part of 1923. The cost of production work was carried out in three typical barrios (Fugu, Capu, and Bañgac) of Ilagan, Isabela, and covered 100 farms. The cost of production was determined by a close analysis of the various farm operations. To facilitate the taking and recording of the necessary data, prepared questionaires were carried with the investigator on his visits to the farmers. The data on cost of marketing and transportation of the product from Aparri to Manila were taken in Aparri, Cagayan, and also in Ilagan, Isabela.

The results of the study follow:

The average area to a farm in the entire survey is 0.955 hectare, all of which is under cultivation.

The terms of a typical tenancy contract in tobacco production are: The tenant furnishes all the labor and working capital; the landlord furnishes the land; and of the gross cash income, four-fifths goes to the tenant, and one-fifth to the landlord.

The landlord's average expense for interest on the value of his land and the tax he pays is ₱17.50 per hectare. The tenant's average total expense is ₱144.35, excluding the value of his labor and that of his family. To give a nominal value for his labor his investment costs become ₱271.76, giving him an average total cost of production per hectare of ₱311.82.

Of the ₱311.82 (cost of production to the tenant), 40.67 per cent is the cost of the tenant's and tenant's family labor, 20.20 for use of building, 12.65 for use of work animals, 6.20 for general expenses, 5.49 for use of implements, 12.89 for land rent, and 1.70 per cent for outside labor.

The average yield per hectare is 591.10 kilograms of leaf tobacco.

The purchase price of the product per hectare is ₱198.33, which is the gross income. Of this amount, the landlord gets ₱40.06 for his investment cost of ₱17.50. He therefore receives a net profit of ₱22.56 per hectare. The tenant gets a gross income of ₱158.27, giving him a labor income per hectare of ₱13.92. If the nominal value of his labor and that of his family is taken into account which is ₱127.41, he loses ₱113.49 for every hectare.

The terms of tenancy prove to be 10.46 times in favor of the landlord or 10.46 times against the tenant.

Transportation is expensive, and the *uno-con-otro* method of marketing is unsatisfactory. It costs ₱4.88 to transport a bale of tobacco from the farm to Manila, or ₱25.08 for the production of one hectare.

The buyer gets most of the profit in tobacco production; for from his total cost of ₱22,270.66 for the entire survey, he gets a return of ₱31,807.46, or a net gain of ₱9,356.80 which means a profit of 43.27 per cent.

Among the investigator's recommendations are: Increased size of farms, diversification of crops, an equitable contract between landlord and tenant, improvement of methods of culture to increase production and lower cost, better marketing by enforcing grading rules and use of co-operative associations, cheaper transportation facilities, and extension of credits to the farmers.

Abstract by Francisco M. Sacay
Of the Department of Rural Economics

THE GOOD FARMER IS GOOD BUSINESS MAN

"Many persons can feed a cow well, or fertilize a crop properly, but those who can run a farm successfully are in a different and much smaller class," says Dr. G. F. Warren of the state college of agriculture at Ithaca, New York.

"Successful farming consists in keeping a balance of all the factors of production in such a way as to realize the maximum profit from each," according to Dr. Warren. "A man may conduct a number of individual enterprises on his farm fairly well, but he may fall down badly on some others and thus lose out in the long run. The successful business man or farmer is dealing constantly with a large number of highly variable factors.

"Statistics show, for example, that the profits above interest on capital and farm wages for the farmer's time, on 680 dairy farms vary one hundred and seventeen times as much as does the length of men's forearms, which is a fair sample of biologic variation.

"A farmer's profits will depend on the amount of work done per man, the number of men on the farm, and the yields of individual crops. Even more complicated and variable for different farms are such items as farm receipts and farm expenses. Anyone who realizes these facts must have considerable respect for the managerial ability of a farmer who remains in business over a series of years."

—*Extension Letter* (University of Hawaii.)

THAT CROP SURPLUS: HOW CHEMISTRY IS HELPING TO SOLVE THE PROBLEM

C. MORAN

A million dollar citrus by-products industry has been established by California fruit growers the last two years, which is a striking example of how to dispose of an agricultural surplus by eating it or wearing it, or as in this case, by drinking it. These growers have decided against decreased production by converting their surplus crops into new forms of food products the demand for which has practically eliminated the surplus problem on citrus fruits.

The surplus consisted of thousands of tons of cull citrus fruits for which there was no market. Chemists took samples of the fruit into the laboratory, and after 10 years of research developed new products which are yielding profits where formerly there were losses.

A commercial method of extracting citric acid from cull lemons has been developed, and organized fruit growers have established a factory where 2 million pounds of acid is produced annually at a net profit of $450,000.00. Forty thousand tons of waste lemons are used in the plant, whereas formerly the growers not only lost the cull fruit but had to pay $1 a ton to dispose of it.

Waste oranges now are being manufactured into juice, marmalade, pectin, orange oil, and other products. One plant, which used 10,000 tons of waste oranges last year, produced 50,000 pounds of orange oil having a wholesale value of approximately $100,000. Another organization prepares orange pulp into feed for dairy cows at a profit of $2,500 a month whereas the disposal of orange pulp formerly cost $800 a month.

A Los Angeles concern uses 60 tons of citrus fruit a day in making juice. As citrus oils are worth approximately $2.50 a pound, the extraction and utilization of the oil means an additional return of $12.50 for each ton of cull fruit, or, on the output of this one plant, a gross additional income of $750 a day.

Government chemists are studying the composition of orange and lemon oils to determine the relative values of the oils for certain uses, such as the manufacture of ice creams, hard candies, cake icings, perfumes and beverages. A machine has been designed to press the oil from orange and lemon peel at the rate of 5 pounds of oil to a ton of fruit.

Chemists have produced, recently, a light-colored, well flavored sirup from pineapple juice, and methods are being developed to concentrate the juice from cores and skins to be used as a vehicle for shredded pineapple

at soda fountains. A satisfactory concentrated juice and jelly have been manufactured experimentally from pomegranates, and several concerns are adopting the method in commercial practice.

The citrus growers have solved their surplus problem with efficient, business-like methods. Waste has been eliminated by utilizing every orange and lemon grown. The walnut growers have eliminated waste by manufacturing charcoal from walnut shells. The charcoal is a high-grade product used in gas masks and other respiration devices, and sells at a profit where formerly the growers paid out real money to have the shells carted away.

Recent chemical research enables producers of other crops to help themselves. Why a corn surplus when there are more than 100 different potential industrial uses for corn? Government economists estimate that cotton consumption can be increased 2 million bales a year by developing new fabrics. Why surplus wheat when the American flax crop is insufficient for domestic needs and more than 30 different uses for flax and flax straw have been developed?

Surplus raisins are to cease being a burden in California, as a result of a process developed recently for turning raisins into a high-grade sirup. A large plant is being erected near Fresno, California, for making a sirup which is said to be one of the sweetest substances known; its color can be controlled, and it is neutral as to taste. Other raisins by-products to be made in this plant include a crude cream of tartar, a stock feed, and a fertilizer containing lime, phosphate and nitrogenous matter. The stock feed is made from raisin pulp from which the sugar has been extracted, and is to be sold largely in California. The by-products plant will employ about 150 persons.

The development of cotton bagging and sacks, and of improved cotton clothing fabrics offers a practical means of increasing the consumption of American cotton. Experiments along this line are being made in Department of Agriculture laboratories and the research laboratories of several state colleges of agriculture. It has been demonstrated that cotton bagging superior to burlap can be manufactured, and bales covered with the new type of fabric are to be shipped in international trade this year to determine how well the cotton covering stands up in actual use. Burlap is made from jute produced in India.

A list of uses of corn, including shelled corn, corn stalks, leaves and cobs ranges over 100 products from acetic acid to toilet soap. It includes axle grease, chair cushions, cigarette holders, cob sidewalks, dolls, door mats, incense, oils, paper, phonograph records, punk, shaving soap, talcum powder, telephone receivers. There is apparently no limit to the quantity of corn which may be grown profitably for utilization in the manufacture of industrial products, certainly small reason for an unmarketable surplus.

Dr. F. B. La Forge of the United States Bureau of Chemistry estimates that from 15 million to 20 million tons of corn cobs are wasted annually on

American farms. Chemists have discovered practical and probably commercial methods whereby 37½ per cent of the corn cob substance can be converted into glucose, 30 per cent into usable mucilage, and 5 per cent into xylose, in addition to much new baking powder material and a large quantity of acetic acid, with probably other valuable by-products yet to be discovered.

Chemical laboratory work has developed cheap processes for extracting from the corn cob a synthetic resin from which telephone receivers, phonograph records, and noiseless gears can be made; furfural which has many uses in industry, including a base for varnish and mucilage; xylan, a valuable base for sulfur dyes; cellulose from which artificial silk is made, and which is used also in waterproofing, paper sizing, and cement. All these materials are obtained now from substances less plentiful and less efficient than corn cobs.

A United States patent has been obtained recently for a process which uses corn cobs in the manufacture of a lumber substitute where high tensile strength is not required. The weight of the material approximates that of light wood and may be shaped by wood-working tools the same as lumber. It may be used for making spools, picture frames, mouldings and wall board.

Similar opportunities in the use of flax seed and seed flax straw have been made possible by recent chemical research. The list of industrial products from this source ranges from artist's oil to upholstery. Utilization of seed flax straw, most of which is burned or otherwise destroyed on farms, includes rugs, fiber board, insulating material, automobile upholstery, car seats, and furniture upholstery.

Strawberry growers have learned to convert their surplus into crushed frozen fruit; surplus cranberries are being made into cranberry sauce put up in cans for the retail trade; apple sauce is being made to a limited extent from surplus crops; a limited quantity of starch is being made from potatoes—potatoes can be used to manufacture industrial alcohol; gas can be manufactured from wheat straw.

"Every part of the tree except the knot hole" is the slogan of chemists who have developed new uses from waste wood. Industry wastes little of raw materials in manufactured products. Agriculture can do likewise by utilizing all of the product of the soil, and the so-called surplus.

—*Capper's Farmer* (Kansas).

The word "research" is such an overworked one used, as some one has recently expressed it, "by many professors for the purpose of reducing university authorities to submission," that one hesitates to use it. But research is simply experience, experiment and fact in the process of formula-

tion. All that text-books hold and all that teachers talk about is somebody's researches in the past. But the research that we shall talk to you about as you go is the past experience lived over or amplified in work of the individual who brings it to you in a fresh and vital form. It is now an accepted truism that no one can teach inspiringly without himself having participated first hand in the evidence which he transmits. And I believe it is almost equally true that no one can investigate to the best advantage without reporting his results to others at intervals; in other words, without teaching.—FREDERICK P. GAY, from *Science*.

I didn't begin with askings, I took *my* job and stuck,
I took the chances *they* wouldn't, and now *they're* calling it luck.

And they asked me how I did it, and I gave'em the Scripture text:
"You keep your light so shining a little in front of the next."

They copied all they could follow, but they couldn't copy *my mind*.
And I left 'em sweating and stealing a year and a half behind.

—*Rudyard Kipling*.

EXTENSION DIVISION NOTES

Diversified Farming

Once more the problem of diversified farming is forcing itself upon the attention of the Filipino farmers. This is strongly exemplified in the case of the tobacco growers in the Cagayan Valley and the rice growers in the principal rice-growing regions of the Islands. Either crop failure or price depression thereof has caused growers to howl for more or less radical remedies, exclaiming: "Had I planted other money crops besides my lone cash crop, the old proverb about *putting all the eggs in one basket would not apply to me.*"

In our last hurried visit to Zambales in a private connection, Zambales farmers were loud in their complaints against the government delaying action on remedial measures to aid agriculture. They were seriously discussing the abandonment of rice production and replacing it with another crop. As to the Cagayan tobacco producers, in spite of sticking to a one-crop-system of farming to the point of facing famine at times they have not to any degree changed their old specialized system. From all indications it seems that the farmers have pinned their hope on emergency measures such as may be taken by the government in time of calamity or crisis, rather than on a stable remedy that they themselves can work out ahead and as a precaution against low production as well as a slump in prices.

The abandonment of a money crop already established in a locality and which has proved to be adapted to the local soil and climatic conditions and the culture and handling of which the farmers and others in the community are most familiar, is, to say the least, a risky proposition. The more so if the new crop selected to replace the old demands a specialized system of farming. In the absence of positive results from previous trials made on the farm, it would be difficult to guarantee a profitable yield and money income as outcome of the new crop. Hence, the farmer is reduced to the rôle of an experimenter rather than a commercial producer, and he must be prepared to take the consequences of the risk involved in running an experiment.

Experimental plantings should be undertaken by the government through its experiment stations. This, however, does not prevent a farmer or a group of farmers from carrying out their own experimental plans. The Hawaii Experiment Station under the direction and financing of the Federal Department of Agriculture is mainly engaged in diversifying Hawaiian cane farming, while the Hawaiian Cane Sugar Association is conducting its own experiments on sugar cane for the sugar cane planters through its own private experiment station.

It seems then that the wisest thing for the farmer to do under such circumstances is to stick to his old crop and improve it in the direction of increasing its yield by proper tillage, timely planting of the crop, use of good seed, rational fertilization, reduction of cost of production and holding the product for a reasonable length of time for a better market price. He should plan for a cropping system better suited to his particular farm if he finds the change advisable with the character of his farm from points of climate, lay and extent of land, kind of soil, and available capital and labor. Then he could gradually evolve a general or diversified system of farming for his farm, bearing in mind the following:

1. That "special farming is the growing of a single crop or at most the growing of one main crop with one or two minor crops."

2. That diversified or mixed farming or general farming "is the growing of several crops of approximately equal importance, and usually includes the keeping of one or more kinds of live stock."

3. That each of the two systems of farming have its advantages and disadvantages, although the diversified system is always cited as being more advantageous than the specialized system for various reasons, of which the two most outstanding and fundamental are: (a) "fertility more easily maintained, (b) better distribution of labor as well as diversity of interest."

The choice, however, of a system of farming largely depends upon many things: "personal likes and dislikes, adaptation of the land and climate; plan of rotation desired; markets to be supplied and labor to be employed."

Example of Diversified Farming

Every year the students taking the course in Coffee (Agronomy 11) in the College of Agriculture are required to make a trip to a barrio Mataas-na-kahoy in Lipa, Batangas. This barrio is widely known for its superior quality of coffee and for its beautiful orchards. Horticulturists from government bureaus and farmers from different regions often visit the place to see its beautiful plantations. The students go there to see coffee plantations being developed on a commercial scale and to hear the experiences of old planters in coffee culture. Many planters in this barrio can speak with authority from actual field experience in coffee culture, as their experience dates back to the time of the famous coffee period in Lipa.

Besides the coffee plantations the students can see an example of diversified farming practiced in a very ingenious way. The practice of diversified farming with annual crops and live stock is quite common. But this case is a diversification of permanent and semi-permanent crops in partial combination with the husbanding of some live stock, such as horses, hogs, and poultry. Coffee and coconuts are the most common combination and in the coconut plantations various other crops are raised in great quantities. Lanzons, not inferior in quality to the Laguna lanzon, supposed to be the best kind in the Islands, are grown, also bananas in large quantities. Also

various other plants as cacao, citrus, chicos, pineapples, kapok, black pepper, etc., are grown. In many cases all these crops are raised with coconut in one lot, so that almost every bit of the ground is planted with something. It is very hard to find in the Islands a locality with an equal degree of diversification. Many of the lots are so full of plants that one might consider them "over-planted" if there is such a word. Of course this practice may be considered unsound from the standpoint of horticulture, but after knowing the conditions obtaining in this barrio, one will be convinced that these farmers are justified in their practice.

There are conditions existing in this progressive barrio which are not very common in other Philippine barrios. It is one of the few barrios in the province of Batangas in which there are very few tenants. The *kasama system* of land tenure is hardly known. The land is very evenly distributed among the people—a condition not common in the old established Philippine communities. Almost every one is sole owner of a piece of land ranging from one-half hectare to about 10 hectares. The most common area possessed by a family is from 2 to 5 hectares, few own more than 30. A hundred-hectare *hacienda* is not to be found. With such even distribution of land every one has an incentive to cultivate his land to its full yielding capacity, because every one has to depend upon his own soil for his subsistence. He has no landlord from whom to get money. He cannot borrow from others unless he mortgages a part of his land; this he cannot afford to do. With the object of getting the most out of his land he plants all kinds of crops that can be grown in the community. This condition of land-owning explains the existence of the diversified farming in Mataas-na-kahoy.

The farmers follow a common procedure, first planting the lot with coconuts. For the first two years rice and corn are raised in the planted lot. Since the coconut does not bear in commercial quantities until after 10 or 12 years, they plant crops that bring quick income, as papayas, bananas, pineapple, coffee, etc. In this way they get something for their support while waiting for the coconut crop. As the coconuts grow, plantations become more and more crowded. By the time the coconuts are bearing, the land in the coconut grove is covered with plants. The farmers do not dare cut out these plants for they know that income from coconut comes only every three months. So in order to have a steady income all the year round they keep these plants. As a matter of fact, the farmers usually plant fruit trees, such as chicos and lanzons which are known to live longer than coconuts.

It is a question whether these farmers would not get more returns by growing only one kind of crop than by the practice they follow. No one questions that the full yielding capacity of one crop is affected because of too much crowding. But no figures have yet been obtained as to which practice would give the most income. But one thing is certain and that is

their incomes are surer by having many crops than by having only one crop. Since they are self-dependent they cannot afford to run the risk of missing their "bread," so they choose the safer course.

This diversified farming by the farmers of Mataas-na-kahoy has hindered the development of a specialized crop, as coffee, into a thriving industry. But they have shown that diversification may solve financial problems of Filipino farmers, where local conditions lend themselves to diversified farming at a profit ultimately greater than can be secured from specialized farming.

Our Most Popular Campus Attraction

The College of Agriculture is now one of the most if not the most popular places for excursionists in the Islands. People from all walks of life, especially students from different educational institutions in Manila and the neighboring provinces, come to the College Campus for a day off. It seems that there is something in the College worth the visit. It may be interesting to know what places in the College are the most attractive. As taste and appreciation vary with individuals, choice as to our attractive spots will vary. There may be some who may like best the beauty of the College environs. There may be others who are serious minded enough to realize the significance of our experimental ground and scientific laboratories where search for truth for the improvement of Philippine agriculture is carried on. And there may be still some who are more impressed by the panorama of the College Campus as a whole. But undoubtedly the great majority of those with a degree of aesthetic sense who visit the College will unanimously declare that the College ornamental nursery is the most attractive spot on the whole College Campus. Indeed, a good number of excursionists who come care to see only the ornamental nursery and fail to visit the other instructive places of the College. We often fear that they may have the idea that the College can produce only something that pleases the eye.

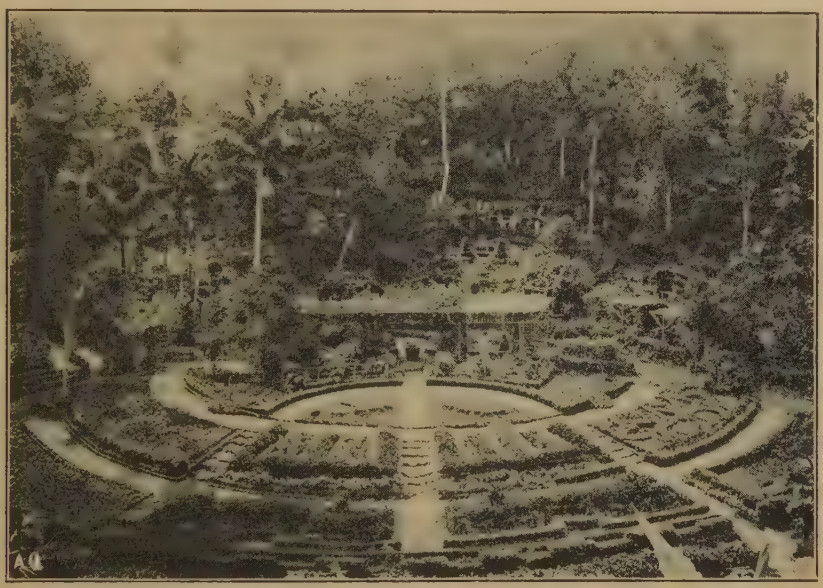
We can easily say that the nursery of ornamentals though scarcely half a hectare in area is the best known spot on our 300 hectares of the College ground including the experiment station. It is the spot most frequented and best remembered by all College visitors. One instance may be cited to indicate the impression that it makes on our visitors.

One time a prominent University professor, after having been shown all that the College usually shows our visitors, expressed his impressions of the College Campus. He made a speech before a crowd, in which he made the College ornamental nursery his central topic. The thing that impressed him the most is that out of inexpensive local ornamentals, instead of imported materials, the elaboration of the ornamental nursery has been ingeniously effected. "It is remarkable," he said, "that men could make a combination of nature's simple resources and produce so highly pleasing

an effect. It is true that there are many beautiful flower gardens in Manila and other places, but in those places a considerable amount of money has been spent for imported materials and such artificial structures as glass houses, elaborate sheds, and trellises, and cement outlines. Such things do not impress one so much as when such beautiful things are made with simple things of nature at an expense within the reach of modest human effort."

In his speech the College professor unconsciously voiced the opinions of thousands who have been similarly impressed by the College ornamental nursery for which Mr. Vicente Dawis, instructor in Agronomy, and his class and assistants in landscape gardening are largely responsible.

The text figure bears out the Manila professor in his commendatory remarks.



While this feature of the College course of study may appear unimportant in the broad scheme of productive agriculture taught by the College, flower and landscape gardening is one of the most productive forms of agriculture where the demand for flowers and landscape gardening skill, as in Manila and other large cities, is great. Flower gardens in Manila, particularly those run on a scientific basis, have been found to be highly profitable. It constitutes a valuable asset for a farmer who actually does his own farming, whether in a small or large *hacienda*, to break the monotony and drudgery of a country life—inducing the farmer to live on his farm and shun cockpits and other vices often resorted to in days of lay-off on the farm.

Most people define agriculture as an occupation. Modern agriculture is more than that, says Dr. C. C. Taylor, of North Carolina. Farmers raise poultry, for example, not just for the sake of raising poultry. but for food and shelter and luxuries. So agriculture is more than an occupation: *it is a level of life.* And the standard of living is measured in terms of *food, clothes, shelter, health, education, religion, recreation, and social contact.* The task of the agricultural leader, then, is not only to help farm people *obtain dividends,* but to help *convert these dividends into a satisfying life.*

—*Extension Letter* (University of Hawaii).

"Of the total cultivated area of British India, about 84 per cent. is devoted to food crops, about 75 per cent. is devoted to food crops for the people of the country, ten per cent. being exported; about 60 per cent. is devoted to feeding the people of the village where the crops are grown, the rest going to the towns. The problem has twofold aspect: first to grow the food of the people on a smaller area so as to release a larger area whereon to grow money crops, and secondly to discover such food crops as the people will consume and as will respond to intensive cultivation, so that the family may be more fully occupied on the tiny holding with profit to themselves. In brief, it is extremely important to devise a scheme whereby the cultivators will be able to use their present leisure in the profitable cultivation of their holdings. It is doubtful whether any scheme could be evolved to occupy all the present leisure, so that the need for subsidiary industries will remain, but this is outside the scope of the present paper."

EXCHANGE NOTES

Lack of uniformity is the great fault with bacon. This is largely due to multiplicity of breeds which vary in type, and are mostly not suitable for the production of a high class product. The bacon type is that which produces the bulk of the meat in the most valuable parts, and the least weight in those parts which are of lower quality and value. In short, nearly all the meat behind the girth or shoulder is worth about twice as much as that in front of the girth. Some breeds are noted for a great crest on the neck, heavy shoulder and jowl, the production of which represents a waste of good food. Others have light neck, shoulders, and jowl, are narrow at the wither, getting heavy towards the hindquarters, and have a long side, thick flank, and full thigh. This is the bacon type. How are we to produce it?

—*Journal of Agriculture* (Victoria, Australia).

Next year you will be celebrating a very interesting anniversary because it was in the year 1878 that Sir Henry Wickham brought those famous seeds from the Amazon to Kew.

Those together with Gold Coast cocoa form two of the most amazing romances of science and industry. Fifty years ago those seeds were brought to Kew and germinated under glass there, and carried out first to Ceylon and then on to Malaya, and from these has sprung the gigantic industry the toast to which it is my privilege to propose. The Gold Coast industry developed much on the same lines. They had not heard of cocoa there but a chance individual brought a cocoa bean to the mainland and planted it, with the result that last year just over half the world's supply was produced by one British possession overseas. Those are the romances of tropical agriculture. There is therefore no reason why that should not be done in other cases.

—*The Planter* (F. M. S.).

Most farmers think it's a good idea to feed their hogs salt, but they don't all know how much to feed. A heaping teaspoonful of salt to a pound of grain is about right. Of course, the quantity to feed depends on the size of the pigs and on whether the animals have been getting salt regularly. If you hold back the salt for some time—then feed it in large quantities, it may cause trouble, even death. The hogs should get small amounts of salt as a regular thing in the ration.

—*American Swineherd* (Chicago, Illinois).

At the present time eleven-twelfths of the value of the agricultural products of Queensland are marketed through a co-operative system under the control of the producers themselves. It has been estimated that during the financial year that has just closed the value to the agriculturists of Queensland in the increased returns as a result of co-operatively controlled marketing exceeded £1,000,000 sterling.

—*Agricultural Journal* (Queensland).

As everyone knows, the avocado, or alligator pear—the poor man's butter—is grown everywhere throughout Jamaica up to say about 3,000 feet, no one however has ever selected varieties and we have scores of different types. There are also varieties we have read of in Guatemala and Mexico which grow up to 5,000 feet and which would be very suitable for the mountains here. In fact they do not seem to flourish in the lowlands in these countries. Varieties from these parts have been introduced into Florida and Southern California and have been tested. Out of the varieties very few have been found to suit conditions and they had to be selected. This selection of course took a period of years. The trees, however, can be budded so that poorer varieties can be made to bear selected varieties. It would be exceedingly useful if we could pick out good types here and only grow these.

The writer shipped pears to the British Empire Exhibition successfully, but it took a great deal of selection to find varieties that would keep and yet were good for the table.

There are here, round varieties and bottle-neck varieties, shiny green varieties, and red and purple varieties; the red and purple varieties should be done away with, although these are just the kinds that grow best in the high hills.

—*Journal Agricultural Society* (Jamaica).

"Australian tobacco interests are concerned about tobacco-aroma," reports Mr. T. H. Patterson, Fields Division. "American leaf is the standard for the world. Is aroma due to soil or climate, or do both combine to produce aroma? These are the questions awaiting answers. Sufficient soil was brought from North Carolina, where it is considered the best leaf is grown, to lay down two plots—one fertilized, the other not. Side by side are two plots of Australian soil taken from Bathurst Experimental Farm, where the trials are being conducted, one being fertilized and the other not. The soil is set on concrete, with concrete divisions, to prevent seepage from the soil outside from plot to plot. The cost of bringing the soil was about £200. The Australian leaf aroma is different from that of American, and the smoker looks for the latter, as he is accustomed to it."

—*Journal of Agriculture* (New Zealand).

COLLEGE AND ALUMNI NOTES

The appointment of José S. Camus, B. Agr., '14, as Assistant Director of the Bureau of Agriculture was confirmed by the Senate in its executive meeting of November 8, 1927.

The *Committee Reports for the Fifth Annual Convention* of the Philippine Sugar Association, held in Manila September 12–17, 1927, lists among the contributors Dr. Manuel L. Roxas, Dr. G. O. Ocfemia, Dr. Leopoldo B. Uichanco, and Mr. Francisco Sacay of the College faculty; and Mr. F. Q. Otanes, Mr. Mariano G. Medalla, Mr. Segundo D. Labayen, and Mr. Benjamin Hollero from the College Alumni.

Doctor Roxas, as chairman of the Committee on "Cane Varieties, Diseases and Fertilizers," submitted a report covering ninety-eight pages of the printed proceedings.

On Sunday evening October 30, 1927, by invitation, Rev. Hugh Bousman, Student Pastor, Student Union Church, presented in the College Auditorium a play, "The Runaway Slave". This short drama, written by Mr. and Mrs. Bousman, is based on the Apostle Paul's letter to Philemon.

The characters in order of their appearance were:

Roman soldiers	Thomas Tate
	Esteban Sadang
Timothy	Domingo Tugade
Paul, A Roman Prisoner	Charlebois Case
Onesimus, A Runaway Slave	Luis Segovia
Philemon, Master of Onesimus	Celestino Razón
Archippus, Philemon's son	Honorio Ylizarde
Apphia, Philemon's wife	Ernesto Lopez
Jason and Lucius, slaves	Thomas Tate
	Esteban Sadang

The first scene was in Paul's prison cell.

The second in Philemon's home.

Much care had been taken in costuming the play and in giving the proper scenic and lighting effects. To students who saw the play, Paul will be a more real individual than before; Philemon, his friend, a very human man. Not soon will they forget the colorful costumes, the dramatic lines and action by which this bit of the past in the day of Rome's far-reaching power was made real.

The community "sings" that were held in 1923–25 under the leadership of Professor E. Gertrude Madison, of the Department of English have been revived this year with Mrs. Hugh Bousman as the leader and with Professor Roa as the accompanist.

Both faculty members and students attend the "sings" which are held on Monday evenings in the Auditorium.

The U. P. Soccer Football Championship for 1927–1928 was definitely decided on November 6, when the invading U. P. Manila team won a hard fought game from the U. P. Los Baños aggregation on the latter's home grounds. The score was 3 to 2. The U. P. Manila team won the first game of the series which was held in Manila on October 30 by the close score of 1 to 0.

As an official University Championship athletic event between the U. P. Manila and Los Baños Units, Soccer Football was adopted in 1925–1926. The Los Baños Colleges' team copped the championship for that year: the Manila team won that of 1926–1928.

Following are the completed events in the 1927–1928 U. P. Los Baños Athletic League, showing the final standings of the competing teams:

BASKETBALL

C. A. Seniors	60	Points (Pennant Winner)
C. A. Sophomores	50	"
C. A. Freshmen	40	"
C. A. Juniors	20	"
Veterinary	20	"
C. A. Preparatory	20	"
Forestry	0	"

VOLLEYBALL

C. A. Preparatory	60	Points (Pennant Winner)
C. A. Sophomores	40	"
C. A. Freshmen	35	"
C. A. Juniors	25	"
Veterinary	20	"
C. A. Seniors	15	"
Forestry	15	"

RELAY CARNIVAL

C. A. Seniors	32	Points (Pennant Winner)
C. A. Freshmen	20	"
C. A. Preparatory	20	"
C. A. Sophomores	12	"
C. A. Juniors	6	"
Forestry	0	"
Veterinary	0	"